EXHIBIT 2

UNITED STATES DISTRICT COURT

NORTHERN DISTRICT OF CALIFORNIA

In Re: DRAM Antitrust Litigation	Master File No. M-02-1486PJH MDL No. 1486
This document relates to all direct actions.	

Expert Report of Paul C. Liu

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I. QUALIFICATIONS

My name is Dr. Paul C. Liu. I am a Principal at *The Brattle Group*, an economic consulting firm with offices in San Francisco, CA, Cambridge, MA, Washington, DC, London, England, and Brussels, Belgium. I have a Ph.D. in Economics from Stanford University. I have worked as an economic consultant for more than ten years on numerous matters involving the use of econometrics to estimate damages. I have consulted for both defendants and plaintiffs. I have testified as an expert economist at mediation and at trial as an economic expert in *Picciotto vs. Zabin* (Massachusetts State Court, Boston, MA). I recently co-authored the chapter on damages (Chapter VII) in the ABA Handbook *Econometrics: Legal, Practical, and Technical Issues.* A copy of my resume detailing my qualifications and prior testimony is attached as Appendix A of this report.

II. ASSIGNMENT

I have been asked by counsel for the plaintiffs to determine whether impact can be established, and if so, to estimate total damages, if any, that have accrued or will accrue to the class members in this case. The class in this case is defined as follows:

> All individuals and entities who, during the period from approximately April 1, 1999 through at least June 30, 2002 (the "Class Period"), purchased DRAM in the United States directly from the defendants or their subsidiaries. Excluded from the class are defendants and their parents, subsidiaries, affiliates, all governmental entities, and co-conspirators.

I have reviewed the *Third Consolidated Amended Class Action Complaint MDL No. 1486 Master File No. M-02-1486PJH* ("the Complaint"), various discovery documents and depositions, and data supplied by the defendants as well as various academic articles and other information from public sources. A list of materials that I have reviewed is attached as Appendix B. My current billing rate on this matter is $365 per hour.

For purposes of this report, I have been asked to make certain assumptions regarding the facts of the case throughout my analysis. In particular, I assume that the defendants entered into a conspiracy to unreasonably restrain trade and commerce in violation of Section 1 of the Sherman Act, 15 U.S.C. §1. On the other hand, though plaintiffs have alleged that defendants "artificially raised, inflated, and sustained the market price of DRAM," I *do not* assume for purposes of my report that the conspiracy was effective in raising prices above the prices that would have pertained absent the alleged conspiracy—as a matter of economics, a price-fixing conspiracy could have been either effective or ineffective in raising price levels. Instead, my conclusions are based on my analysis of the pricing data.

Because discovery is ongoing, I anticipate that I will continue to refine my analysis over the coming weeks as additional information becomes known to me. I may revise or supplement my report as necessary.

III. OVERVIEW

Damages in a price-fixing case can be measured as the difference between actual transaction prices and transaction prices "but for" the alleged conspiracy. Since actual transaction prices are observed, a damage analysis must estimate "but-for" prices. The but-for price by definition is a

hypothetical price. The standard "before-and-after" method uses the following steps to estimate the but-for price. First, a baseline period in which the alleged conspiracy was absent is identified. Second, an economic model of supply and demand is fitted to price data in the baseline period, typically using a standard statistical technique called multiple regression analysis to estimate and control for the effects of various economic factors on prices. Third, this model is used to forecast prices in the class period absent the alleged conspiracy. Fourth, these prices are compared to the actual prices in the class period. A common variant of this method is to estimate the price difference between but-for and actual prices directly. This is accomplished by using the entire period for which data are available and including one or more indicator variables to identify differences between prices during the period of the alleged conspiracy and prices during the baseline period. This is the approach I use for my analysis. In either case, an estimate of damages is obtained by multiplying the estimated percentage price difference by revenues during the period or periods in which the conspiracy was found to be effective.

IV. THE DRAM MARKET

I begin with a review of the relevant characteristics of the DRAM market, and I discuss supply and demand factors pertinent to this industry. This section will serve to motivate the model specification I use: 1) to estimate whether there was any impact of the conspiracy, and 2) if so, to calculate any resulting damages.

A. THE PRODUCTS

Dynamic Random Access Memory (DRAM) products are semiconductor devices used by personal computers, servers, and other electronic products to temporarily store and retrieve data

and programs. DRAM is largely defined along four dimensions: technology, form factor, density, and speed.

The technology indicates how the memory is accessed. Over the time frame of the transaction data, DRAM technology evolved from Extended Data Output (EDO) to Synchronous DRAM (SDRAM) to Double Data Rate (DDR) SDRAM and Rambus DRAM.

The form factor indicates the packaging; typically DRAM is provided in either single component form or as a packaged module consisting of two or more DRAM components affixed to a circuit board.[1] Typical packaged modules include Dual In-line Memory Module (DIMMs) and Rambus In-line Memory Modules (RIMMs).

The density indicates the amount of memory available from the DRAM product. The capacity of these products has increased substantially over time. For example, over the time frame of the transaction data, the capacity of DRAM modules increased from 16 megabytes of capacity to as much as two gigabyte of memory, or 128 times as much.

The speed indicates how quickly the memory can be accessed.[2] The speed of DRAM products in the transaction data began at a data rate of 66 megahertz and eventually reached data rates of up to 800 megahertz.

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[1] See for example, http://www.pcmag.com/encyclopedia_term/0,2542,t=memory+module&i=46780,00.asp, viewed August 27, 2006.

[2] See for example, http://www.interfacebus.com/memory_modules.html, viewed August 27, 2006.

B. SUPPLY FACTORS

DRAM memory technology has been the subject of intense research and development. DRAM products evolve rapidly and have relatively short lifecycles. This is in large part due to "Moore's Law" which states that the density of transistors that can be placed on a semiconductor device doubles every eighteen months on average.[3]

DRAM manufacturing technology can improve along at least two dimensions: the size of the wafer (wafer size) and the width of a feature that can be etched on chip (feature size). The ability to produce DRAM using larger wafers means that one can fit more chips on each wafer which increases output and reduces the processing time needed to produce a set number of chips.[4] According to data from the market research firm iSuppli, in Q1 2002, 99 percent of production used 8 inch wafers, but by Q4 2005 that number had dropped to 51 percent, with the rest being produced on 12 inch wafers. A second dimension of technological innovation is through smaller process technology, cutting each line on the chip with smaller widths. Smaller feature widths (measured in microns or μ) allow more chips to be produced per wafer.[5] In Q1 1998 the average process technology was 0.31 μ but by Q4 2000 the average process technology was 0.188 μ, a reduction of approximately 40 percent.[6] Micron's website indicates

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[3] See Van Zant, P., *Microchip Fabrication*, 5th Edition (2004), Chapter 1; John Hannibal Stokes, "Understanding Moore's Law", http://arstechnica.com/articles/paedia/cpu/moore.ars/1, viewed August 26, 2006; and Michael Kanellow, "FAQ: Forty years of Moore's Law," http://news.com.com/FAQ+Forty+years+of+Moores+Law/2100-1006_3-5647824.html, viewed August 26, 2006.

[4] Van Zant, P., *Microchip Fabrication*, 5th Edition (2004), Chapter 1; Chip Weems, Lecture Notes, http://www.cs.umass.edu/~weems/CmpSci635A/635lecture2.html, viewed August 26, 2006.

[5] Van Zant, P., *Microchip Fabrication*, 5th Edition (2004); Eric Bangeman, "RAM prices on the Rise" http://arstechnica.com/news.ars/post/20040414-3654.html, viewed August 26, 2006.

[6] DeDios Presentation, May 1998, ITNA 00026931-50 and DeDios Presentation, April 2001, MU00528030-59.

that currently most of its production uses .11 μ technology.[7] Chip fabrication facilities are tooled for a fixed wafer size and feature size; changing either of these parameters requires expensive retooling.[8] New fabrication facilities can cost several billions of dollars to build.[9]

Though every generation of DRAM memory utilizes improved technologies and production processes, they each have a common feature in that much of the early production is experimental and low yielding. At the start of production, yields may be near zero, but yields increase dramatically over time and it is typical for mature products to have yields of 95 percent or greater.[10] As chip yields increase, the number of wafer starts required to produce a given number of chips drops.[11] Thus unit costs for DRAM chips start high and decline rapidly. Articles in the peer-reviewed economics literature explain this phenomenon through "learning by doing," in which the production processes become more efficient with increases in cumulative production.[12]

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[7] Cheuvreuz, "The Big Fizzle," June 26, 2002, p. 38. (MU00327388-MU00327458); http://www.micron.com/investors/faq_product.

[8] John Hannibal Stokes, "Understanding Moore's Law,", http://arstechnica.com/articles/paedia/cpu/moore.ars/2, viewed August 26, 2006.

[9] Van Zant, P., *Microchip Fabrication,* 5th Edition (2004) Chapter 15; Cheuvreuz, "The Big Fizzle," June 26, 2002, p. 142 (MU00327388-MU00327458); ING Barings, "Hyundai Electronics Inc. – Buy (Initiating Coverage)", p. 6. (MU00116813-MU00116867); IC Knowledge LLC, "Can the semiconductor industry afford the cost of new Fabs?" http://www.icknowledge.com/economics/fab_costs.html, viewed August 26, 2006.

[10] Van Zant, P., *Microchip Fabrication,* 5th Edition (2004), p. 489.

[11] Cheuvreuz, "The Big Fizzle," June 26, 2002, p. 18. (MU00327388-MU00327458): "Increasing the number of (good) dies per wafer is the only way to lower manufacturing costs."

[12] Zulehner, "Testing Dynamic Oligopolistic Interaction: Evidence from the Semiconductor Industry," International Journal of Industrial Organization, December 2003, 21(10): 1527-56; Gruber, *Learning and Strategic Product Innovation: Theory and Evidence for the Semiconductor Industry*, 1994; Irwin and Klenow, "Learning-by-Doing Spillovers in the Semiconductor Industry," *Journal of Political Economy 102* (1994), pp. 1200-27, and Siebert, "Learning By doing and Multiproduction Effects over the Life Cycle: Evidence from the Semiconductor Industry" discussion Paper FS IV 02-23, Wissenschafttszentrum Berlin, 2002.

In addition to yield-related costs, other input costs to DRAM include electricity prices, silicon prices, wage costs, and the cost of capital.[13]

D. Demand Factors

About 65 to 70 percent of all DRAM is used in personal computers.[14] Servers and workstations account for another 10 to 14 percent of all DRAM, for a total of 78 to 83 percent attributable to computer applications.[15] More recent sources put the share of DRAM in computer applications as high as 90 percent.[16] It is thus not surprising that most DRAM market analysts point to PC units shipped as the key demand factor used to explain price fluctuations in the DRAM market.[17]

V. DATA

Data from DeDios Associates' *DRAM Market Advisor* ("DeDios") and transactions data from the defendants provide two distinct sources of price data. I use both datasets, separately, in my analysis.

First, I rely on DRAM price data from the DeDios reports. The DeDios reports include market prices for major customers, second-tier customers, and spot price customers. As Professor Noll concluded in his Class Certification Expert Report, these prices generally move together with

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[13] Zulehner, "Testing Dynamic Oligopolistic Interaction: Evidence from the Semiconductor Industry" International Journal of Industrial Organization, December 2003, 21(10): 1527-56 and Park, Kyoung, "Estimation of Dynamic Behavior with Learning: Application to the DRAM Industry," Dissertation, Cornell University, 2002.

[14] Cheuvreuz, "The Big Fizzle," June 26, 2002, p. 19. (MU00327388-MU00327458).

[15] Cheuvreuz, "The Big Fizzle," June 26, 2002, p. 19. (MU00327388-MU00327458). The remaining share consists of videogame consoles at 2 to 3 percentage points and "Other (cons., comms, industrial)" at 15 to 19 percentage points.

[16] http://www.via.com.tw/en/downloads/presentations/events/vtf2004/keynote_infineon.pdf.

[17] See for instance, DeDios DRAM Market Advisor, February 1998, page 3, December 2002, page 2, August 2003, page 4; Garber, Sherry "The Division of the DRAM Market" Semico Report, April 1999, page 4.

spot prices tending to lead contract prices.[18] I analyze prices for the DRAM products listed in the DeDios reports during the Class Period. For these DRAM products, I collect price data from the DeDios reports from January 1997 to December 2004.

Second, I rely on transactions data provided by the defendants, which span the period January 1996 to December 2004.[19] These data are generally individual transaction data which include product description, revenue, units sold and approximate date of a sale or group of sales along with a description of the customer, though certain data are more aggregated. I received data from Micron and its subsidiary Crucial, as well as data from Samsung, Winbond, NEC, Elpida, Infineon, Mosel Vitelic, Nanya and Hynix. In Appendix C, I describe the data management steps that were performed on these data.

VI. ESTIMATION OF IMPACT AND DAMAGES

A. Periods of Analysis

The Class Period in this matter is April 1999 to June 2002. Both the DeDios and transaction data span the Class Period as well as substantial periods before and after the Class Period.

Professor Noll in his Liability Expert Report opines the following: 1) That "by no later than April 1998, communication was extensive among all of the major DRAM suppliers about prices generally and with respect to major OEMs"[20]; 2) That "by late August, when prices were being set for September, the major suppliers were explicit in making commitments to each other about

[18] Class Certification Expert Report of Roger G. Noll, ¶52.

[19] Infineon provided a small amount of data from the final months of 1995 and Nanya provided data that stretched into July of 2005. Because competitor data was unavailable and the amount of data was small it was excluded.

future price changes"[21]; 3) That "the nature of the communications among the defendants changed in early 2001"[22]; 4) That "the evidence shows that the existence of a strategy to drive Hynix from the market was in place by late March 2001"[23]; and 5) That "the attack against Hynix ended in November of 2001, and was replaced by another period in which the defendants sought to increase prices"[24] Based on Professor Noll's Liability Expert Report as well as my own review of the discovery record, I distinguish seven subperiods for analysis:

1) May 1998 to August 1998 ("*transition0*")

2) September 1998 to March 1999 ("*preclass*").

3) April 1999 to December 2000 ("*conspire1*").[25]

4) January 2001 to March 2001 ("*transition1*").

5) April 2001 to October 2001 ("*predatory*").[26]

6) November 2001 ("*transition2*").

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[20] Liability Expert Report of Roger G. Noll, pp. 17-18.
[21] Liability Expert Report of Roger G. Noll, p. 18.
[22] Liability Expert Report of Roger G. Noll, p. 20.
[23] Liability Expert Report of Roger G. Noll, p. 5.
[24] Liability Expert Report of Roger G. Noll, pp. 5.
[25] Emails in this period included the following: August 9, 1999, between Micron and Toshiba: "I just talked to Toshiba and have agreed to hold price this week and next [MU00315771]; March 27, 2000, between Micron, Hyundai, Fujitsu, Samsung, and Infineon: "Mickey and Yama [both Micron], please talk to Hyundai, Fujitsu, Samsung, and Infineon today and let them know that Micron is raising prices this week. Bill talked to Infineon on Friday…so they are aware of what Micron is planning… Things are going to get fun once again!" [MU00773494]; May 25, 2000, between Micron, Hyundai, and Samsung: "Met with Hyundai and Samsung folks today for a few beers. Interesting to know that Hyundai is cutting their allocation to half from 4M/qtr to 2M/qtr to Maxtor. Samsung is out of the picture since they have indicated the 1Mx16 at $3.50. Samsung is selling the 1Mx16 to WD at $3.25 while Seagate is at $3.30. Looks like we might want to increase pricing or reduce qty to Maxtor based on this info" [MU00193220]; July 2000, between Infineon, Samsung, Micron, and Hyundai: "Pricing: Everyone looking to raise August 1" [ITNA01074225]; August 25, 2000, between Infineon, Micron, Samsung, and Hyundai: "I have talked to Micron, Samsung, and Hyundai, and all three swear they have made no movement on price. Samsung and Micron say they are still at $67.00 and Hyundai is at $66.50." [ITNA01200094].
[26] Emails in this period included the following: June 12, 2001, from Hynix: "I am going to have a dinner meeting with Mr. Florian , VP, Sales and Marketing, Infineon next Monday. I will find out if Infineon really wants us out of the market.... You would think there is someway to stop this… Why can't we call a cease fire for one month… and get some stabilization" [HSA, BYRD, C. 109550].

7) December 2001 to June 2002 ("*conspire2*").[27]

The periods excluded from this list form my baseline. For the DeDios data, this consists of the periods from January 1997 to April 1998 and from July 2002 to December 2004. For the transaction data, this consists of the periods from January 1996 to April 1998 and from July 2002 to December 2004.

B. Multiple Regression Analysis using the DeDios Data

I conduct a multiple regression analysis where I estimate a standard reduced form equation with log of price as my dependent variable and various supply and demand factors as my explanatory variables. The reduced form equation describes the intersection of supply and demand in the DRAM market. For demand factors, I include the number of personal computers starts[28] and the number of web server starts.[29] I allow these factors to vary by DRAM product. For supply factors, I include the price of various inputs, including electricity, wages, silicon, and capital.[30]

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[27] Emails that discussed this period included the following: November 13, 2001, from Micron: "With the market giving us an unexpected (and largely unexplainable) bump in spot pricing and demand, I think it is time to give our customers another thing to think about. I would like to immediately reduce hub inventory to 50% as a guideline" [MU00187896]; November 14, 2001, from Micron: "Unless there is a very good reason to do otherwise, I would like us to pull inventory out of offsite hubs such that we only have 3-4 days worth of material in place and monitor inventory going into hubs such that we don't exceed this level. As the customers pull, we can/should replenish but I would like to facilitate the perception of uneasiness and, in the event that we are able to effect a price increase, I want to prohibit OEMs from draining hubs at lower than market prices. Please get this done ASAP." [MU00131927]. November 15, 2001, from Hynix: "Micron is reducing Apple hub inventories in order to create artificial shortage and will follow SS or Hynix, if Apple accepts a price increase" [HSA: SWANSON 66693- HSA: SWANSON 66694].

[28] I use the log form for this variable. This variable is constructed as follows: 1) isuppli Corporation provided quarterly worldwide PC units (Desktop PCs, Mobile PCs and Entry-level Servers) shipped for 2002 to 2005; 2) annual data were obtained from isupply for 1998-2001 and from IDC for 1996 and 1997 (ITNA00073992.pdf, page 14); 3) Seasonal fixed effects were estimated from the quarterly data from 2002 to 2005 and applied to the annual data from 1996 to 2001.

[29] Total monthly web server counts were obtained from http://survey.netcraft.com/Reports/. The number of web server starts was calculated by taking the month-to-month difference in web server counts after

In addition, I include a specification to account for learning-by-doing. Various marginal cost specifications have been posited in the learning-by-doing literature. For example, Gruber (1994) and Irwin and Klenow (1994) use marginal cost as a concave power function in cumulative output: $MC=AV^B$, where MC is marginal cost, V is cumulative output and A and B are parameters. Zulehner (2003) posits marginal cost as a linear function of cumulative output. Comparisons with DRAM cost curves suggest that an appropriate specification should be monotonically declining and convex. Both the power function above as well as the exponential form, $MC = \alpha \exp(-\omega V)$, where V is cumulative output and α and ω are parameters, satisfy these criteria.

DeDios data do not contain quantities or cumulative output. However, if quantities are roughly constant in each period, then cumulative output can be estimated as $V = V_0 \times (t - t_0)$. Then if marginal costs follow an exponential form, the log of marginal costs is equal to $\ln(MC) = \ln \alpha - \omega V = \alpha' + \omega' \times (t - t_0)$ where $\alpha' = \ln \alpha$ and $\omega' = \omega V_0$. Alternatively, if marginal costs follow a power form, the log of marginal costs is equal to $\ln(MC) = \ln A + B \ln V = A' + B' \times \ln(t - t_0)$, where $A' = \ln A + B \ln V_0$ and $B' = B$. The curvature

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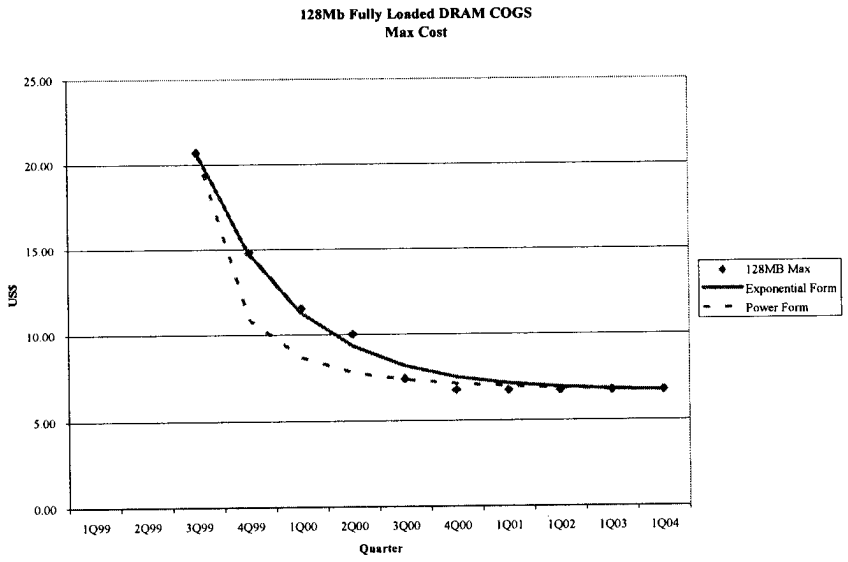
adjusting for a typical 48-month replacement cycle. See for example www.dod.mil/comptroller/defbudget/fy2004/budget_justification/pdfs/rdtande/DCMA_RDTE.pdf, viewed August 25, 2006.

[30] I use the log form for these variables. The price of silicon from 1997 to 2004 is from Hong Kong FOB from Metals Bulletin; for annual silicon prices for 1996 are from Metals Week as reported by the U.S. Geological Survey (http://minerals.usgs.gov/minerals/pubs/commodity/silicon/760798.pdf, downloaded July 25, 2006) and given seasonal factors based on the prices in Metals Bulletin. Electricity prices are from OECD/IEA – Industrial End Users and averaged across the countries in which fabrication facilities could be identified. Wages are from the OECD and BLS and averaged across the countries in which fabrication facilities could be identified. The cost of capital is proxied using interest rates from the IMF, OECD, Central Bank of Singapore, Central Bank of Taiwan (officially called Central Bank of China), Central Bank of Indonesia and the Central Bank of Portugal, based on the home country for each company.

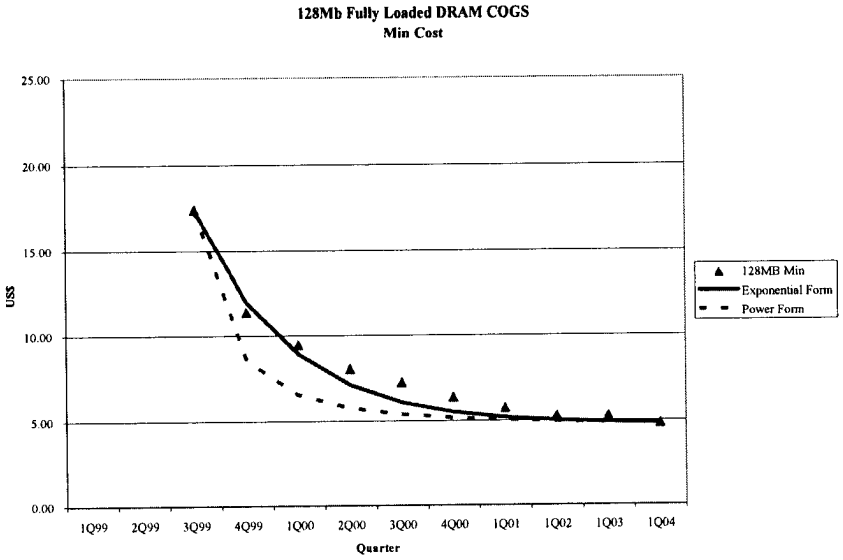
of DRAM cost data when graphed against time may be better fitted with the exponential form than with the power form. See Figures 1 and 2 below.[31]

Figure 1



[31] ING Barings, "Hyundai Electronics Inc. – Buy (Initiating Coverage)", p. 23. (MU00116813-MU00116867). The curvature of 64Mb DRAM costs as listed in the presentation also appears to be better fitted with the exponential form than with the power form. In Figures 1 and 2, I have fitted to the endpoints, which more readily shows the curvature limitations of each form.

Figure 2



Additionally, I include monthly dummies to control for seasonality,[32] a time trend variable, and variables for type of customer – major, second-tier, and spot. Finally, I include indicator variables for each of the seven subperiods discussed previously.

I estimate the following specification:

$$\ln(P_{ict}) = \alpha_0 + \sum_i (\alpha_{1,i} + \alpha_{2,i}(t - t_{0,i}))D_i + \pi_1 \ln(p_{silicon,t}) + \pi_2 \ln(p_{wages,t}) + \pi_3 \ln(p_{elec,t}) + \pi_4 \ln(p_{capital,t})$$
$$+ \sum_i \delta_i D_i \ln(pcstarts_t) + \sum_i \omega_i D_i \ln(webstarts_t) + \sum_m \mu_m month_m + \varsigma\, moyr + \sum_c \kappa_c ctype_c$$
$$+ \beta_0\, transition0 + \beta_1\, preclass$$
$$+ \beta_2\, conspire1 + \beta_3\, transition1 + \beta_4\, predatory + \beta_5\, transition2 + \beta_6\, conspire2$$
$$+ \varepsilon_{ict}$$

[32] I note that Ms. Guerin-Calvert indicated in her Class Certification Expert Report that seasonality was likely to be a factor in DRAM pricing. I would expect that there would be seasonal differences in demand arising from the fact that rapid technological change makes holding DRAM inventory costly. See also Cheuvreuz, "The Big Fizzle," June 26, 2002, p. 19. (MU00327388-MU00327458)

where

i, c, t = DRAM product i, customer class c, time t

$t - t_{0,i}$: time since initial introduction of product i

D_i = 1 if product i, 0 otherwise

$\ln(p_{silicon,t})$, $\ln(p_{wages,t})$, $\ln(p_{elec,t})$, $\ln(p_{capital,t})$: the log of the prices of silicon, wages, electricity, and capital, respectively

$\ln(pcstarts_t)$: the log of the number of pc starts

$\ln(webstarts_t)$: the log of the number of web server starts

$month_m$ = 1 if time t is in month m, 0 otherwise

moyr = months since January 1996

ctype = 1 if customer type c (c = major, second-tier, spot), 0 otherwise

transition0: equals 1 if date is between May 1, 1998 and August 31, 1998, 0 otherwise

preclass: equals 1 if date is between September 1, 1998 and March 31, 1999, 0 otherwise

conspire1: equals 1 if date is between April 1, 1999 and December 31, 2000, 0 otherwise

transition1: equals 1 if date is between January 1, 2001 and March 31, 2001

predatory: equals 1 if date is between April 1, 2001 and October 31, 2001, 0 otherwise

transition2: equals 1 if date is between November 1, 2001 and November 30, 2001, 0 otherwise

conspire2: equals 1 if date is between December 1, 2001 and June 30, 2002, 0 otherwise.

The main results are shown in Table 1 below:

Table 1
Regression Results from DeDios Data

Regression statistics			
	Number of obs	=	3635
	F(210, 3424)	=	518.73
	Prob > F	=	0
	R-squared	=	0.9695
	Adj R-squared	=	0.9677
	Root MSE	=	0.24641

Variable	Description	Coefficient	Std. Err.	T-Statistic	Percent
moyr	Months since January 1996	(0.1785)	0.1736	(1.03)	-16.35%
_Imonth_2	February	0.0611	0.0219	2.79	6.30%
_Imonth_3	March	0.0382	0.0214	1.79	3.90%
_Imonth_4	April	0.1996	0.0244	8.17	22.09%
_Imonth_5	May	0.1669	0.0262	6.38	18.16%
_Imonth_6	June	0.1108	0.0277	4.00	11.72%
_Imonth_7	July	0.2511	0.0253	9.91	28.54%
_Imonth_8	August	0.3289	0.0258	12.74	38.95%
_Imonth_9	September	0.1956	0.0261	7.48	21.61%
_Imonth_10	October	(0.0385)	0.0237	(1.63)	-3.78%
_Imonth_11	November	0.0317	0.0239	1.33	3.22%
_Imonth_12	December	(0.0713)	0.0237	(3.01)	-6.88%
_Ictype_2	Second-Tier	(0.0243)	0.0124	(1.96)	-2.40%
_Ictype_3	Spot	(0.0995)	0.0101	(9.81)	-9.48%
lnpsilicon	Log of Silicon Price	2.1843	0.1434	15.23	
lnwage	Log of Wage	3.5429	0.3393	10.44	
lnelec	Log of Electricity	0.8921	0.0874	10.21	
lnint	Log of Interest Rate	0.1355	0.0564	2.40	
transition0	May 1998 to Aug. 1998	(0.1581)	0.0335	(4.72)	-14.62%
preclass	Sep. 1998 to Mar. 1999	0.1779	0.0399	4.46	19.47%
pricefix1	Apr. 1999 to Dec. 2000	0.2711	0.0532	5.10	31.14%
transition1	Jan. 2001 to Mar. 2001	0.1093	0.0476	2.30	11.55%
predatory	Apr. 2001 to Oct. 2001	(0.2361)	0.0438	(5.39)	-21.03%
transition2	Nov. 2001	(0.3760)	0.0594	(6.33)	-31.34%
pricefix2	Dec. 2001 to Jun. 2002	0.4648	0.0319	14.57	59.17%

Note: Omitted categories are January, major customers.
Product-specific coefficients (standalone and interacted with t-t0, lnpcstarts, and lnwebstarts) omitted for brevity.
Percent calculated as exp(coefficient) - 1.

The full estimation is presented in Appendix D. Because the dependent variable is the log of price, the percent impact of the coefficients in the table above is calculated as the exponent of the coefficient.[33] I find price elevations of 19.47 percent, 31.14 percent, 11.55 percent, and 59.17 percent for the "preclass," "pricefix1," "transition1," and "pricefix2" subperiods, respectively, which are all statistically significant at the 95 percent confidence level most commonly used. I fail to find price elevation for any of the "transition0," "predatory," or "transition2" subperiods.

I also investigated a functional form which allows for greater flexibility in the curvature. Specifically, I normalized $(t - t_0)$ and $\ln(t - t_0)$ by their respective means and weighted by λ:

$$\ln(MC_i) = c_i + \lambda \frac{t - t_{0,i}}{E_i(t - t_{0,i})} + (1 - \lambda) \frac{\ln(t - t_{0,i})}{E_i(\ln(t - t_{0,i}))},$$

where $E_i(.)$ represents taking the average over product i. This allows for the possibility of fitting a power function, an exponential function, or something in between. I performed a grid search over the interval [0, 1] for the value of λ which gave the best fit, as measured by the sum of squared residuals.[34] Using a grid spacing of 0.1, I arrived at an estimate of λ of 0.9, which indicates that the best-fit curvature with respect to time since introduction is very close to the exponential form I estimate above.

[33] In other words, if $\ln(P_{actual}) = \ln(P_{but\text{-}for}) + \beta_i$, then the price elevation $(P_{actual} - P_{but\text{-}for}) / P_{but\text{-}for} = \exp(\beta_i) - 1$.

[34] This method gives coefficient estimates that converge to those found by nonlinear least squares as the fineness of the grid increases. See for example, Greene, Econometric Analysis, 5th Edition (2003), p. 174

C. Multiple Regression Analysis using the Transaction Data

The transaction data can be used in a multiple regression analysis in a very similar fashion to the DeDios data. I aggregate the transaction data into product-month observations. The following aspects of the analysis are identical to the DeDios analysis:

- I use as my dependent variable the log of price.
- I allow demand, as measured by the number of PC starts and the number of web server starts, to vary by DRAM product.
- I allow learning-by-doing costs to vary by DRAM product. I also include as supply factors the price of various inputs, including electricity, wages, silicon, and capital.
- I include monthly dummies to control for seasonality as well as a time trend variable.
- I include seven subperiod variables, *transition0*, *preclass*, *conspire1*, *transition1*, *predatory*, *transition2*, and *conspire2*, defined the same as before.

I now discuss the differences.

First, because the transaction data do not consistently identify "major customers," "second-tier" customers, and "spot price" transactions, I do not separately identify customer type.

Second, because the transaction data continue to contain some apparently erroneous or suspect data, I have screened out certain transaction level observations.[35] I have also screened out any observations in the aggregated product-month data that show month-to-month log price ratios of greater than 0.3 or less than -0.4,[36] which if applied to the DeDios data would filter out only 3

[35] I manually reviewed the transaction data and dropped approximately 2 percent of the observations due to variance suggestive of recording or other errors in the raw data.

[36] The asymmetry is due to the fact that the average month-to-month log price ratios are on average declining.

percent of the observations. In the transaction data, however, this screens out approximately 22 percent of the observations.

Third, I weight the observations by total quantities over time of the corresponding DRAM product (*i.e.*, each product has a fixed weight). This places greater weight on the DRAM products with more unit sales, to account for differences in the underlying uncertainty associated with estimating average price.

Fourth, the learning-by-doing literature on DRAM typically models marginal cost as a power function in cumulative output: $MC=AV^B$, where MC is marginal cost and V is cumulative output and A and B are parameters.[37] As my dependent variable is log of price, the appropriate marginal cost measure is the log of marginal cost, $\ln(MC_t) = \ln A + B \ln V_t$, which implies that the log of cumulative output is the appropriate explanatory variable when cumulative output is available, as it is in this case.

Then the specification I estimate is the following:

$$\begin{aligned}\ln(P_{it}) = \alpha_0 &+ \sum_i (\alpha_{1,i} + \alpha_{2,i} \ln V_{i,t}) D_i + \pi_1 \ln(p_{silicon,t}) + \pi_2 \ln(p_{wages,t}) + \pi_3 \ln(p_{elec,t}) + \pi_4 \ln(p_{capital,t}) \\ &+ \sum_i \delta_i D_i \ln(pcstarts_t) + \sum_i \omega_i D_i \ln(webstarts_t) + \sum_m \mu_m month_m + \varsigma\, moyr \\ &+ \beta_0\, transition0 + \beta_1\, preclass \\ &+ \beta_2\, conspire1 + \beta_3\, transition1 + \beta_4\, predatory + \beta_5\, transition2 + \beta_6\, conspire2 \\ &+ \varepsilon_{ict}\end{aligned}$$

with the variables defined the same as previously, with the exception that the subscript c is dropped. Table 2 displays the key results.

[37] Gruber (1994) and Irwin and Klenow (1994).

Table 2
Regression Results from Transaction Data

Regression statistics			
	Number of obs	=	4742
	F(818, 3923)	=	64.24
	Prob > F	=	0
	R-squared	=	0.9305
	Adj R-squared	=	0.916
	Root MSE	=	0.3005

Variable	Description	Coefficient	Std. Err.	T-Statistic	Percent
moyr	Months since January 1996	(0.0140)	0.0014	(10.11)	-1.39%
_lmonth_2	February	0.0468	0.0232	2.02	4.79%
_lmonth_3	March	0.0361	0.0229	1.58	3.68%
_lmonth_4	April	0.2197	0.0257	8.55	24.57%
_lmonth_5	May	0.2126	0.0266	7.98	23.68%
_lmonth_6	June	0.2052	0.0273	7.53	22.77%
_lmonth_7	July	0.1813	0.0249	7.27	19.87%
_lmonth_8	August	0.2073	0.0247	8.40	23.03%
_lmonth_9	September	0.1536	0.0254	6.06	16.60%
_lmonth_10	October	(0.0840)	0.0246	(3.41)	-8.06%
_lmonth_11	November	0.0058	0.0248	0.23	0.58%
_lmonth_12	December	(0.0484)	0.0239	(2.03)	-4.73%
lnpsilicon	Log of Silicon Price	0.9115	0.0978	9.32	
lnwage	Log of Wage	(0.0224)	0.1509	(0.15)	
lnelec	Log of Electricity	0.5920	0.0984	6.02	
lnint	Log of Interest Rate	0.6497	0.0532	12.20	
transition0	May 1998 to Aug. 1998	(0.3493)	0.0433	(8.06)	-29.48%
preclass	Sep. 1998 to Mar. 1999	0.1458	0.0354	4.12	15.69%
pricefix1	Apr. 1999 to Dec. 2000	0.2885	0.0371	7.78	33.44%
transition1	Jan. 2001 to Mar. 2001	0.3353	0.0332	10.08	39.83%
predatory	Apr. 2001 to Oct. 2001	(0.4509)	0.0317	(14.21)	-36.29%
transition2	Nov. 2001	(0.7805)	0.0565	(13.82)	-54.18%
pricefix2	Dec. 2001 to Jun. 2002	0.2034	0.0303	6.72	22.56%

Note: Omitted category is January.
Product-specific coefficients (standalone and interacted with t-t0, lnpcstarts, and lnwebstarts) omitted for brevity.
Percent calculated as exp(coefficient) - 1.

The full estimation is presented in Appendix D. I find price elevations of 15.69 percent, 33.44 percent, 39.83 percent, and 22.56 percent for the "preclass," "pricefix1," "transition1," and "pricefix2" subperiods, respectively, which are all statistically significant at the 95 percent

confidence level most commonly used. I fail to find price elevation for any of the "transition0," "predatory," or "transition2" subperiods.

As with the DeDios data, here I also investigated a functional form which allows for greater flexibility in the curvature. Specifically, I normalized for V_t and $\ln V_t$, and weighted by λ:

$$\ln(MC_i) = c_i + \lambda \frac{V_{i,t}}{E_i(V_{i,t})} + (1-\lambda)\frac{\ln V_{i,t}}{E_i(\ln V_{i,t})},$$

where $E_i(.)$ represents taking the average. I again performed a grid search over the interval [0, 1] for the value of λ which gave the best fit, as measured by the sum of squared residuals.[38] Using a spacing of 0.1 gave an estimate of λ of 0.0, which indicates that the best-fit curvature with respect to cumulative output (as opposed to time since introduction in the DeDios data) is the power form I estimate above.

D. Computation of Damages

To calculate damages for the subperiods in the Class Period which exhibit price elevation ("pricefix1," "transition1," and "pricefix2" in both the DeDios and transaction analyses) I first calculate price levels that would have pertained absent the price elevation. Since the actual prices are elevated by the percentages given in Tables 1 and 2, but-for prices are equal to the actual prices divided by (one plus the percentage elevation), or equivalently, by the exponent of the coefficient.[39]

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[38] This method gives coefficient estimates that converge to those found by nonlinear least squares as the fineness of the grid increases.

[39] In other words, if $\ln(P_{actual}) = \ln(P_{but\text{-}for}) + \beta_i$, then percent damages = $(P_{actual} - P_{but\text{-}for}) / P_{actual} = 1 - 1/\exp(\beta_i)$.

For the DeDios data, I calculate that but-for prices would have been 23.75 percent, 10.35 percent, and 37.18 percent lower in the "conspire1," "transition1," and "conspire2" subperiods, respectively. Damages are computed by multiplying these percentages by the total dollar sales of DRAM products during these periods, $14.002 billion, $1.588 billion, and $2.538 billion, respectively. I find no damages for either of the remaining subperiods within the Class Period, "predatory" and "transition2." I estimate damages to be $3.325 billion in the subperiod April 1999 to December 2000, $164 million in the subperiod January 2001 to March 2001, and $943 million in the subperiod December 2001 to June 2002, for a total of $4.433 billion and an average percent damage of 22.09 percent during the Class Period. See Rows [2] and [5] in Table 3 below. Using the more flexible functional form with λ=0.9 gives similar total damages of $4.258 billion and an average percent damage of 21.21 percent. See Row [6] in Table 3 below.

Table 3: Damages
(Dollars in millions)

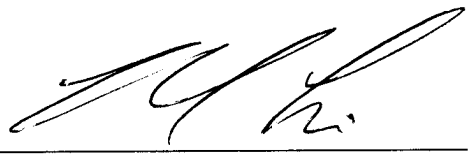
	Conspire1 Apr. 1, 1999 - Dec. 31, 2000	Transition 1 Jan 1,2001 - Mar. 31,2001	Predatory Apr. 1, 2001 - Oct. 31, 2001	Transition 2 Nov. 2001	Conspire2 Dec. 1, 2001 - Jun. 30,2002	Total Apr. 1, 1999 - Jun. 30, 2002
[1] **Total Revenue**	$ 14,002	$ 1,588	$ 1,731	$ 212	$ 2,538	$ 20,071
Percent Damages						
[2] DeDios Data	23.75%	10.35%	0.00%	0.00%	37.18%	22.09%
[3] with alt. curvature	23.85%	11.52%	0.00%	0.00%	28.97%	21.21%
[4] Transactions Data	25.06%	28.49%	0.00%	0.00%	18.40%	22.06%
Damages						
[5] DeDios Data	$ 3,325	$ 164	$ -	$ -	$ 943	$ 4,433
[6] with alt. curvature	$ 3,339	$ 183	$ -	$ -	$ 735	$ 4,258
[7] Transaction Data	$ 3,509	$ 452	$ -	$ -	$ 467	$ 4,428

Sources and Notes:
Total revenue is calculated from Defendants' transaction records and is net of returns.
Percent damages calculated as 1 - 1/exp(coefficient).

For the transaction data, I calculate that but-for prices would have been 25.06 percent, 28.49 percent, and 18.40 percent lower in the "conspire1," "transition1," and "conspire2" subperiods, respectively. I estimate damages to be $3.509 billion in the subperiod April 1999 to December 2000, $452 million in the subperiod January 2001 to March 2001, and $467 million in the subperiod December 2001 to June 2002, for a total $4.428 billion and an average percent damage of 22.06 percent during the Class Period. See Rows [4] and [7] in Table 3.

Based on these results, I find that the DeDios and transactions analyses give consistent estimates of total damages during the Class Period. I conclude, based on the information presently known to me, that damages from April 1, 1999 through June 30, 2002 are between $4.258 and $4.433 billion, or between 21.21 percent and 22.09 percent of revenues observed during the Class Period.

I declare that the foregoing is true to the best of my knowledge and belief.



Paul C. Liu

Executed at San Francisco, California, on August 28, 2006.

APPENDIX A

APPENDIX A: CV OF PAUL LIU, PH.D.

PAUL C. LIU **Principal**

Dr. Liu is an economist with expertise in the areas of applied econometrics, antitrust and environmental economics, and utility risk management. He has assisted counsel on numerous antitrust, environmental, product liability, and breach of contract damage cases. Dr. Liu has testified in Massachusetts State Court and before mediators. For electric utility clients, he has developed tools for valuing hedging strategies, standard offer service, and embedded options for power plants. Dr. Liu holds a Ph.D. in Economics from Stanford University and a B.A. in Economics and Applied Mathematics from the University of California at Berkeley.

PROFESSIONAL EXPERIENCE

Antitrust Litigation

- Dr. Liu managed a team of analysts who examined multi-gigabyte datasets consisting of many millions of transactions in a case involving allegations of a price fixing conspiracy among producers of a textile product.

- Dr. Liu critiqued opposing expert reports and developed trial exhibits for Professor Daniel McFadden in a case involving allegations of a price fixing conspiracy among producers of industrial-grade silicon.

- Dr. Liu worked with Professor Daniel McFadden on a Daubert declaration critiquing the use of statistical analyses for establishing liability in a price-fixing case involving a consumer food product.

- Dr. Liu worked with Professor Daniel McFadden on an amicus brief critiquing the statistical damage analysis performed by the plaintiff's expert in a case involving allegations of illegal marketing actions taken by the defendant due to its dominant position in its consumer product industry.

- Dr. Liu assisted defense counsel with class certification issues in *Re: Resident Physicians Antitrust Litigation.* In that matter, a class of medical

residents alleged that a nationwide conspiracy among residency programs led to suppressed stipends.

- Dr. Liu managed the project team that provided economic damage analysis on behalf of Netscape in its antitrust action against Microsoft. Dr. Liu guided the development of a state-of-the-art dynamic market model to estimate the impact of Microsoft's anti-competitive conduct on the market share of Netscape's Navigator browser.

- Dr. Liu assisted several companies involved in the production of computer hardware and internet software with the estimation of damages resulting from antitrust violations by competitors.

- Dr. Liu worked with Professor Stewart Myers in an antitrust case involving the credit card industry. Dr. Liu directed a number of analyses, assisted in preparing the expert report, and supported counsel at the deposition of the opposing expert.

Arbitration

- Dr. Liu and other members of *The Brattle Group* including Professor Daniel McFadden (who was awarded the 2000 Nobel Memorial Prize in Economics) were retained by the state attorneys generals of the Settling States and the Original Participating Tobacco Manufacturers to determine whether the provisions of the 1997 Master Settlement Agreement were a Significant Factor in the Market Share Loss of the Participating Manufacturers.

Commercial Litigation

- In a legal malpractice suit in which the plaintiffs sued their original counsel, Dr. Liu testified at trial on behalf of the original counsel. The original suit involved a used car dealer seeking to recover damages incurred as a result of emissions from a nearby tannery. Plaintiffs won the original suit but alleged that an additional lost sales analysis should have been presented. At the malpractice trial which concluded in January 2002, Dr. Liu rebutted the claim by the plaintiffs' economic expert that the lost sales analysis presented would have formed a reliable basis for damages at

the time of the original trial. The jury found for the original counsel on all counts.

- Dr. Liu directed the damages analysis on behalf of the defendant in a suit filed by a major semiconductor company against a chemical manufacturing firm in which the semiconductor company alleged that the chemical firm provided it with contaminated chemicals that resulted in damaged wafers and lost sales.

- In a case involving a consumer food product in which the defendant had made factually inaccurate statements concerning the nutritional content of the plaintiff's product, Dr. Liu assisted plaintiff's counsel by critiquing the damages analysis performed by the court-appointed expert and preparing exhibits which demonstrated the shortcomings of the expert's methodology.

- Dr. Liu assisted counsel in a dispute over the number of qualified claims in an asbestos matter. Specifically, Dr. Liu evaluated the validity of the statistical methodology used by the opposing expert.

- Dr. Liu worked with Professor Stewart Myers on a project involving a dispute on the valuation of a power plant which entered into a purchased power agreement which was subsequently breached.

- For a corporate client involved in a bankruptcy proceeding, Dr. Liu performed valuations of commodity contracts with imbedded options.

Property Value Diminution Damage Claims

- In a class action involving allegations of property value diminution in an area surrounding a landfill, Dr. Liu directed an analysis of property values for a class of several hundred residential properties. Dr. Liu testified at the mediation on behalf of the defendants.

- In a major class action alleging diminution in property values near the Rocky Flats nuclear weapons facility, Dr. Liu analyzed property values for a class including twelve thousand residential properties. Over fifteen thousand real estate transactions for properties in the class and control areas were used. Dr. Liu directed the research for rebuttal of the key

opposing expert and worked with Professor Daniel McFadden on a rebuttal report. He also supported counsel at the deposition of the opposing expert.

- In another class action, a class consisting of tens of thousands of properties alleged that property values had been adversely affected due to proximity to a Superfund site. Dr. Liu directed an econometric analysis of potential property value impacts using over thirteen thousand real estate transactions. Dr. Liu testified at a mock trial held by the defendants.

- In a potential class action involving hundreds of properties in the proximity of a railroad switching yard where contamination had occurred, Dr. Liu assisted counsel on possible analyses that could be used to rebut plaintiffs motion for class certification.

- For a case involving alleged property value impacts at a residential golf community, Dr. Liu assisted in an analysis of property values and in the preparation of a damage assessment report for mediation.

Economic Benefit of Non-Compliance

- Dr. Liu analyzed the economic benefits of alleged non-compliance at a large petrochemical plant. This analysis involved a detailed investigation of the impacts of earlier installation of several production technologies on production and revenues. Dr. Liu assisted in the preparation of expert reports, critiqued opposing expert reports, supported counsel at the deposition of the opposing expert, and developed exhibits for trial.

- Dr. Liu analyzed the economic benefits of alleged non-compliance at a specialty chemicals plant. The issues involved an economic comparison between wastewater treatment and deep-well injection.

- Dr. Liu worked with plant managers and technical experts to analyze the economic benefits of alleged non-compliance at a specialty chemicals plant.

Utility Risk Management

- For a utility seeking to demonstrate prudency of its procurement of power in order to recover costs in excess of established rates, Dr. Liu analyzed its procurement strategy and assisted in preparing testimony on the prudency of its procurement.

- For a utility seeking to demonstrate the potential exposure associated with being the Provider of Last Resort for large non-residential customers, Dr. Liu prepared analyses that showed the differences in valuations associated with minimum term commitments of varying durations.

- For a utility seeking to demonstrate prudency of expenditures on forward contracts used to hedge against spot market price volatility, Dr. Liu developed a multiple-factor price and load model which could estimate an optimal hedging strategy while recognizing limitations of the market.

- Also for this utility, Dr. Liu constructed a model which calculated the option value of offering price cap service, given uncertainty in the power market. Restrictions on the price cap, such as an annual commitment to the price cap service and fees for switching between the market and the price cap service, were also explored.

- For a utility seeking optional electric power, Dr. Liu constructed a valuation model that evaluated the bids received, given uncertainty in both power and fuel markets. The valuation model was extended to value several of the utility's current and potential holdings for strategic positioning.

- Also for this utility, Dr. Liu constructed models of electricity prices which could be used to value complex products and contracts.

- For the Electric Power Research Institute (EPRI), Dr. Liu constructed a model for valuation of nuclear power plant options, including an early retirement option and a life extension option, given volatility in future electric power prices.

- In another EPRI project, Dr. Liu assisted with the development of software that helps utilities manage risks in their power portfolios.

- Also for EPRI, Dr. Liu performed statistical analyses of the natural gas futures and options markets, in order to enable EPRI and its member utilities to better understand market phenomenon such as patterns in volatility.

Regulation

- Dr. Liu assisted the Newspaper Association of America in the R2000-1 postal rate proceedings. Dr. Liu evaluated the Postal Service's rate proposal for Standard Mail (A), prepared interrogatories and interrogatory responses, worked with Dr. William B. Tye in the preparation of his direct testimony, prepared Dr. Tye for oral cross-examination, and evaluated intervenor testimonies.

- For a railroad client involved in rate tariff litigation, Dr. Liu constructed a model to capture the impacts of entry into the railroad market. This model was a core component of testimony by Professor Stewart Myers in this case and several cases which followed.

- Dr. Liu managed a project involving an income tax dispute between a large petroleum firm and the State of Alaska. He helped structure and coordinate the presentation of expert testimony by Professor Stewart Myers. He also assisted Professor Myers in preparing for his deposition.

- For an electric utility cooperative that was on the verge of bankruptcy, Dr. Liu assisted in preparing a restructuring proposal for the Board of Directors that would enable the utility to retain financial independence.

- For a large client in the UK natural gas market, Dr. Liu prepared detailed revenue requirement models, revenue models, and rate and asset trajectories in consulting with the client on regulatory matters in the UK.

AWARDS AND HONORS

Center for Economic Policy Research/Bradley Foundation Fellowship, 1994-95.
Stanford University Graduate Fellowship, 1990-91.
U. C. Berkeley Chancellor's Fellowship, 1986-90.
U. C. Berkeley Alumni Scholarship, 1986-87.

TESTIMONY

Damages testimony in *Picciotto vs. Zabin* (Massachusetts State Court, Boston, MA), 2001.

PAPERS AND PRESENTATIONS

"Chapter VII: Damages" in *Econometrics: Legal, Practical, and Technical Issues*, with Daniel McFadden, Kenneth Wise, and Susan Guthrie. American Bar Association Handbook, 2006.

"Access Pricing and Investment in Local Exchange Infrastructure," with William Zarakas, Glenn Woroch, Lisa Wood, Daniel McFadden, and Nauman Ilias. March 2, 2005.

"The Browser War - Econometric Analysis of Markov Perfect Equilibrium in Markets with Network Effects," with Mark Jenkins, Rosa Matzkin, and Daniel McFadden. April 22, 2004. Revised April 13, 2005.

"The Misuse of Econometrics in Litigation," with Daniel McFadden, Kenneth Wise, and Susan Guthrie, working paper, 2003.

"Response to Nelson Lipshutz's 'Consumer Impacts of Substituting Radian Lien Protection Coverage for Refinance Lender's Title Insurance,'" May 30, 2003.

"The Increase in Consumer Surplus from Radian Lien Protection: The California Market, Supplemental Report on Home Equity Loans," March 20, 2003.

"The Increase in Consumer Surplus from Radian Lien Protection: The California Market," December 11, 2002.

"REX Incentives: PBR Choices that Reflect Firms' Performance Expectations," with Johannes P. Pfeifenberger and Paul R. Carpenter, *The Electricity Journal*, Vol. 14, No. 9, November 2001.

"Measuring Mountains and Molehills: Property Impact Claims," with Kenneth T. Wise and Matthew A. Barmack, presented at the 8th Section Fall Meeting of the American Bar Association Section of Environment, Energy, and Resources, New Orleans, Louisiana, September 20-24, 2000.

"Price Caps for Standard Offer Service: A Hidden Stranded Cost," with Frank Graves, *The Electricity Journal*, Vol. 11, No. 3, December 1998.

"Price Caps for Standard Offer Service: A Hidden Stranded Cost," Stranded Cost Determination and Securitization Conference, Denver, Colorado, December 2-3, 1997.

"Regulator Inspection and Violation Deterrence," working paper, March 1996.

"Regulator Inspection and Violation Deterrence under Clean Water Act Regulation of Pulp and Paper Mill Water Pollution," Dissertation, September 1995.

"Regulatory Inspections and Violation Deterrence," WEA Annual Conference, sponsored by Western Economic Association International, San Diego, California, July 5-9, 1995.

"The Effectiveness of Punishment in Deterring Behavior," APPAM Annual Meetings, sponsored by Association for Public Policy Analysis and Management Meetings, Chicago, Illinois, October 27-29, 1994.

"Structural Modeling of Regulator Inspection and Firm Compliance," California Workshop on Environmental and Resource Economics, sponsored by Browning-Ferris Industries and University of California, Office of the President, Santa Barbara, California, October 21-22, 1994.

APPENDIX B

APPENDIX B: DATA AND DOCUMENTS REVIEWED

EXPERT TESTIMONY

1) Expert Report of Margaret E. Guerin-Calvert, March 10, 2006. Master File No. M-02-1486PJH, MDL No. 1486
2) Attachment to the Expert Report of Margaret E. Guerin-Calvert
3) Electronic materials submitted with the Expert Report of Margaret E. Guerin-Calvert
4) Deposition of Margaret Guerin-Calvert, April 7, 2006
5) Expert Report of Roger G. Noll, April 19, 2006. Master File No. M-02-1486 PJH, MDL No. 1486
6) Reply Report of Roger G. Noll, May 17, 2006. Master File No. M-02-1486 PJH, MDL No. 1486

DEPOSITIONS REVIEWED

Defendant	Witness	Date
Hynix	J. G. Nam	5/11/2006
Hynix	Gary Swanson	4/27/2006
Hynix	Abed Kassak	4/21/2006
Hynix	Charles Byrd	4/20/2006
Hynix	Farhad Tabrizi	4/7/2006
Hynix	Michael Peterson	4/5/2006
Hynix	Jerome McBroom	3/29/2006
Hynix	Albert Boro, Jr.	2/10/2006
Hynix	Duk Il Shin	2/9/2006
Hynix	Lin Lee	2/9/2006
Hynix	Hyun-Jun Kim	2/8/2006
Hynix	Myung Ro Lee	2/8/2006
Hynix	Paul Palonsky	5/9/2006
Infineon	Guenter Hefner	5/10/2006
Infineon	Heinrich Florian	5/9/2006
Infineon	Peter Schaefer	5/8/2006
Infineon	Steven Wahl	4/25/2006
Infineon	T. Rudd Corwin	4/13/2006
Infineon	John Bugee	4/6/2006
Infineon	Michael Pitzer	3/30/2006
Micron	Thomas Addie	5/24/2006
Micron	Keith Weinstock	5/12/2006
Micron	Steve Appleton	5/9/2006
Micron	Lionel Lim	5/8/2006
Micron	Dan Morrissey	4/25/2006
Micron	Linda Turner	4/14/2006
Micron	Alfred Censullo	4/11/2006
Micron	Kathy Radford	4/5/2006
Micron	Steven Thorsen	3/24/2006
Micron	Bill Lauer	3/21/2006
Mosel	Rajit Shah	5/11/2006
Mosel	Ronald Farrell	5/9/2006
Mosel	Kim Michael Ramirez	5/5/2006
Mosel	Yu Sheng Li	5/3/2006
Mosel	Frederick Smith	5/2/2006
Mosel	Frederick Smith (30)(b)(6)	5/2/2006
Mosel	Nathan Handelsman	5/1/2006
Mosel	John Seto	4/18/2006
Nanya	Steve Hsu	6/29/2006
Nanya	Michael Patrick Walsh	6/28/2006
Nanya	Kenneth Hurley	6/16/2006
Nanya	David Dwyer	6/14/2006
Nanya	Wen Chu	6/14/2006
Nanya	Brian Donahue	6/12/2006
Nanya	Steve Wang	4/17/2006
Nanya	Pamela Chen	3/29/2006
NEC	Roy Brents	7/6/2006
NEC	Akifumi Takayasu	6/14/2006
NEC	Richard Russell Cripps	5/5/2006
NEC	Bart Ladd	5/3/2006
NEC	Donna Hatcher	3/2/2006
NEC	Dennis Scott	3/1/2006
Elpida	Yasukazu Inoue	6/22/2006
Elpida	Michael Despotes	5/22/2006
Elpida	Phillip Hassett	5/12/2006
Elpida	Ali Farahbod	5/9/2006
Elpida	Daniel Donabedian	4/27/2006
Elpida	Dimitrios Sogas	4/25/2006
Elpida	Thomas Panacci	4/25/2006
Elpida	Karen Buse	3/21/2006

Micron	Jon Ostberg	3/14/2006	Elpida	Curt Anderson	3/20/2006
Micron	Fred Waddel	3/10/2006	Elpida	Arun Aggarwal	3/20/2006
Micron	John Landreth	3/3/2006	Winbond	Ronald Abruzzese	7/6/2006
Micron	Roger Hawkins	2/28/2006	Winbond	Larry Gaddy	6/30/2006
Micron	Brice Arave	2/14/2006	Winbond	John Eideh	6/28/2006
Micron	Julie Kay Smith	2/14/2006	Hynix	Hyun Jun Kim	7/11/2006
Winbond	Stefan Schauss	7/25/2006	Hynix	I.J. Kim	7/12/2006
	Akihiko Furusawa	8/1/2006	Hynix	K.C. Suh	7/25/2006
Elpida	David Lin	7/20/2006	Hynix	Chae Kyun Chung	7/27/2006
Micron	Michael Sadler	7/7/2006	Mosel	Mohammad Iqbal	4/27/2006
Nec	Tatsuya Iida	7/14/2006			

DECLARATIONS

7) Declaration of Michael Bokan
8) Declaration of Wen C. Chu
9) Delcaration of Chih Fan Hsu
10) Declaration of Jeong Gyun Nam
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CONTRACTS REVIEWED

Manufacturer	Customer	Date	Bates Number
Crucial	Apple (Master Purchase Agreement)	8/10/2000	MIC0000655- MIC0000673
Crucial (Micron)	Apple	8/10/2000	MU00515024- MU00515025
Dell	Siemens (Non-Disclosure)	9/1997	ITNA00023002- ITNA00023009
Elpida	Blank Distributor Agreement		EMUS058930- EMUS060223
Elpida	Celestica (Terms and Conditions)	2002	EMUS069119- EMUS069130
Elpida	Compaq (Electronic Business Agreement)	3/1/2001	EMUS121204- EMUS121212 EMUS121903- EMUS121907
Elpida	Compaq (Purchase Agreement & Long Term Purchase Agreement & supplemental terms)	2000 1/1/2001	EMUS124550- EMUS124566 EMUS124567- EMUS124568 EMUS124570- EMUS124588 EMUS125276- EMUS125293 EMUS125295- EMUS125350 EMUS125434- EMUS125450 EMUS125745- EMUS125883 EMUS125896- EMUS125919 EMUS126273- EMUS126296 EMUS128635- EMUS128653 EMUS129502- EMUS129538 EMUS129606- EMUS129613 EMUS129792- EMUS129858 EMUS129871- EMUS129894
Elpida	Dell (Memo of Understanding)		EMUS048652

Manufacturer	Customer	Date	Bates Number
Elpida	Dell		EMUS121215- EMUS121219 EMUS121222- EMUS121226 EMUS121229- EMUS121233 EMUS121910- EMUS121914
Elpida	Exel (Supplier Warehouse Agreement)	1/1/2002	EMUS156687- EMUS156701 EMUS159574- EMUS159588
Elpida	Hitachi (Consignment Agreement)	2000	EMUS123822- EMUS123850 EMUS123852- EMUS123880 EMUS124204- EMUS124216 EMUS124218- EMUS124230 EMUS125061- EMUS125073 EMUS127847- EMUS127875 EMUS127931- EMUS127959 EMUS128306- EMUS128318 EMUS129411- EMUS129423
Elpida	SCI (Master Supply Agreement)	11/2002	EMUS069021- EMUS069032
Elpida	Selectron (Replenishment Program)	12/31/2001	EMUS069394- EMUS069398
Elpida	Silicon Graphics	1/22/2002 1/30/2002	EMUS070121- EMUS070134 EMUS070749- EMUS070762
Elpida	SMART (Consignment Agreement)	3/1/2001	EMUS126198- EMUS126241
Hynix	(Celestica) Supplier Managed Inventory Agreement	4/1/2001	0000337850- 0000337864
Hynix	Agilent	12/1998	0000236045
Hynix	Apple (Rebate Reimbursement Agreement)	7/1/2001	0000207434- 0000207436

Manufacturer	Customer	Date	Bates Number
Hynix	SMART	3/18/1998	0000327808- 0000327809 0000381631- 0000381635 0000333636- 0000333636
Hynix	Thomson Multimedia (Letter of Intent0		0000139794- 0000141917
Hyundai	IBM (Purchase Agreement)	1/3/2000	0000111280
Infineon	Apacer (Consignment Agreement)	5/6/1999	ITNA01005319- ITNA01005396
Infineon	Apple (Master Goods Agreement & Request for Quotation & Confidentiality Agreement)	12/4/2002	ITNA01092641- ITNA01092654 ITNA01092657- ITNA01092670 ITNA01092834- ITNA01092844 ITNA01092920- ITNA01092923
Infineon	Avnet (Consignment Agreement)	2001	ITNA01023452- ITNA01023459 ITNA01023462- ITNA01023470
Infineon	Blank sample agreements		ITNA01011567- ITNA01011568 ITNA01026160 ITNA01026172- ITNA01026174 ITNA01026181- ITNA01026183 ITNA01026190- ITNA01026191 ITNA01026221- ITNA01026222 ITNA01009296- ITNA01009296 ITNA01009296- ITNA01009303 ITNA01030477 ITNA01045433- ITNA01045447 ITNA01102729
Infineon	Broadbus		ITNA01295346- ITNA01295356
Infineon	Broadbus (Basic Supply Agreement)	4/2002	ITNA01028563- ITNA01028572
Infineon	Cisco		ITNA01029659- ITNA01029687

Manufacturer	Customer	Date	Bates Number
Infineon	Cisco (Basic Supply Agreement) & Affidavit		ITNA01029659- ITNA01029687 ITNA01029696- ITNA01029748 ITNA01028980- ITNA01028981
Infineon	Cisco (Volume Purchase Agreement)	2000	ITNA01029753- ITNA01029810
Infineon	Compaq (Amendment to Computer Corporate Purchase Agreement	1/1/2000 10/24/2000 71//2001	ITNA01032001 ITNA01032008 ITNA01032013- ITNA01032014 ITNA01032015- ITNA01032034 ITNA01031628- ITNA01031632 ITNA01032036- ITNA01032040
Infineon	CTI DRAFT (Logistics Services Agreement)	2000	ITNA01030402- ITNA01030424 ITNA01030429- ITNA01030449 ITNA01030454- ITNA01030476
Infineon	Dataram	9/15/2000	ITNA01005653- ITNA01005653
Infineon	Dell	9/11/2001	ITNA01247274- ITNA01247295
Infineon	Dell (Master Purchase Agreement, Memo of Understanding & Correspondence)		ITNA01079963- ITNA01079981 ITNA01080019- ITNA01080023 ITNA01080623- ITNA01080633 ITNA01090024- ITNA01090027
Infineon	Digital Equipment Corporation		ITNA00024340- ITNA00024690
Infineon	EMC		ITNA01038233- ITNA01038234
Infineon	General Conditions for the supply of goods and services of the electrical and electronics industry		ITNA01029360- ITNA01029364 ITNA01030098- ITNA01030102
Infineon	Hewlett-Packard	2002	ITNA01312682- ITNA01312739 ITNA01312680
Infineon	Hewlett-Packard	10/2001	ITNA01227413- ITNA01227420

Manufacturer	Customer	Date	Bates Number
Infineon	Hewlett-Packard (Non-Disclosure Agreement & Order Terms)		ITNA00035926-ITNA00036010 ITNA00042112-ITNA00042162 ITNA01090702-ITNA01090707
Infineon	Intel Addendum E	2/4/2000	ITNA01025514-ITNA01025515
Infineon	Kingston (Purchase Agreement)		ITNA01007846-ITNA01007853
Infineon	Legacy	March 15, 2001	ITNA01041943-ITNA01041951
Infineon	Legacy (Basic Purchase Agreement)	10/15/1999 3/15/2001	ITNA01041550-ITNA01041557 ITNA01041561-ITNA01041568 ITNA01041932-ITNA01041940 ITNA01041943-ITNA01041951
Infineon	Legacy (Strategic Supply Agreement)	3/15/2001	ITNA01042005-ITNA01042014 ITNA01042039-ITNA01042058
Infineon	Motorola		ITNA01045155-ITNA01045160
Infineon	Norcomp (Representative Agreement)	7/15/2001 And appendix	ITNA01028497-ITNA01028511 ITNA01028561-ITNA01028561

Manufacturer	Customer	Date	Bates Number
Infineon	PNY (Consignment Agreement) & amendments	2/17/2000 7/1999	ITNA00000315-ITNA00000335 ITNA01010500-ITNA01010505 ITNA01011317-ITNA01011322 ITNA01011355-ITNA01011357 ITNA01011361-ITNA01011369 ITNA01011373-ITNA01011378 ITNA01011379-ITNA01011381 TNA01011401-ITNA01011403 ITNA01011405-ITNA01011407 ITNA01011620-ITNA01011624 ITNA01012140-TNA01012242 ITNA01005627-ITNA01005641 ITNA01045532-ITNA01045542
Infineon	Rambus qualification requirements		ITNA01037308-ITNA01037309
Infineon	Siemens	10/15/1999	ITNA01037793-ITNA01037798
Infineon	Silicon Motion	5/2000	ITNA01047983 ITNA01047993-ITNA01047994 ITNA01047997
Infineon	Smart	4/9/2002	ITNA01099642-ITNA01099651
Infineon	Sony	2000	ITNA01049825 ITNA01050375-ITNA01050414
Infineon	Sun	10/8/2000	ITNA01095144-ITNA01095155
Infineon	Synnex	1999	ITNA01052510-ITNA01052517
Infineon	Viking	5/2001	ITNA00002356-ITNA00002385 ITNA00002389-ITNA00002407 ITNA01000710-ITNA01000719 ITNA01000740-ITNA01000749

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Infineon	Visiontek	5/6/1999	ITNA01054292- ITNA01054297
Infineon	Wistron	7/13/2001	ITNA01034727- ITNA01034728
Infineon Technologies AG (German)	Apple	2001	ITNA01092641- ITNA01092654
Infineon Technologies AG (German)	Gateway	1999	ITNA01305929- ITNA01305942 & ITNA01305886- ITNA01305928
Micron	3Com Ireland	6/1/2001	MIC0000739- MIC0000744
Micron	Agilent	2/12/2002	MIC0000276- MIC0000279
Micron	Agilent (Purchase Agreement)	11/1/2001	MU00016210- MU00016230
Micron	Alcatel (Purchase Agreement)	6/1/2002	MIC0000384- MIC0000402
Micron	Alcatel Thomson Multimedia (Modem Letter Agreement- Transfer of Business)		MIC0000260- MIC0000263
Micron	Altera	4/23/2002	MIC0000107- MIC0000116
Micron	Apple	8/10/2000	MU00108879- MU00108894
Micron	Apple (Memory Purchase and Supply Agreement)	4/6/2000 8/10/2000	MU00106636- MU00106659 MU00108879- MU00108894
Micron	Bekins	3/15/2000	MU00279827- MU00279842
Micron	Celestica (Supplier Managed Inventory Agreement)	12/14/2000	MU00279957- MU00279961 MU00280150- MU00280151 MU00280131- MU00280133
Micron	CenTech	1/1/1999	MU00279725- MU00279743
Micron	Compaq	10/1/1998	MU00146916- MU00146947

Manufacturer	Customer	Date	Bates Number
Micron	Compaq (Computer Corporation Purchase Agreement)	10/30/1996 10/29/1999 &amendment 6/6/2001 3/25/2002	MIC0000914- MIC0000939 MIC0000919- MIC0000939 MIC0000914- MIC0000918
Micron	Compaq	1998	MIC0000887- MIC0000913
Micron	Compaq	4/10/2001	MIC0002099
Micron	Compaq (Amendment to Corporate Purchase Agreement)	No date 10/1/1998 10/25/1999 8/20/2001 11/1/2001	MU00056836- MU00056838 MU00146916- MU00146947 MU00151575- MU00151618 MU00164466- MU00164468 MU00187761- MU00187763
Micron	Compaq (Warehouse Agreement)	1998	MU00148808- MU00148824
Micron	Compaq (Computer Corporation Purchase Agreement)		MU00312149- MU00312164 MU00312183- MU00312194
Micron	Compaq (Micron Sterling Options Program Business Agreement)	12/1/1998	MU00312165- MU00312182
Micron	Dane-Elec. Corp. (JIT)	9/1/2001 6/30/2002	MIC0000117- MIC0000128 MIC0000268- MIC0000275
Micron	Dell (Webster Rebate Agreement)	12/1/1999	MIC0000686- MIC0000688
Micron	Dell (Long Term Purchase and Supply Agreement)	2/22/2000	MIC0001364- MIC0001385
Micron	Dell (Strategic Purchase Association and Price Commitments)	3/11/2002	MIC0002164- MIC0002180
Micron	Dell (Business Partner Assessment)		MIC0001388- MIC0001387
Micron	Dell (Long Term Purchase and Supply Agreement)	10/27/1998	MU00170278- MU00170300
Micron	Ericsson (Agreement regarding transfer of currents agreements to Ericsson AB)	3/12/2002	MIC0000305- MIC0000320
Micron	Ericsson (Quality Assurance Agreement)	2/28/02	MIC0000141- MIC0000158
Micron	Ericsson (Specific Purchase Agreement)		MIC0000689- MIC0000707

Manufacturer	Customer	Date	Bates Number
Micron	Ericsson (Electronic Data Interchange Agreement = EDI)	3/8/2002	MIC0000463- MIC0000518
Micron	Ericsson (General Purchase Agreement)		MIC0001696- MIC0001723
Micron	Flextronics		MU00024084- MU00024087
Micron	Fujitsu (JIT Agreement)	1/1/2000 1/3/2000 2/24/200 4/1/2000 4/12/2000 4/15/2000 9/19/2001	MIC0001955- MIC0001967 MIC0001943- MIC0001954 MIC0001929- MIC0001942 MIC0001916- MIC0001928 MIC0001853- MIC0001867 MIC0001895- MIC0001906 MIC0001907- MIC0001915
Micron	Fujitsu (Mutual Confidentiality Agreement) & Memo of Understanding	9/27/1999 11/1/2001	MU00381889- MU00381891 MU00383634- MU00383653
Micron	Fujitsu Limited	4/15/1999	MU00670038- MU00670045
Micron	Gateway (Sales and Purchase Agreement)	2/18/2000	MU00279800 MU00279801- MU00279824 MU00279843 MU00279896
Micron	Given Logistics	6/2002	MU00280150- MU00280157
Micron	Hitachi (Purchasing Specs)		MIC0000352- MIC0000357
Micron	Hewlett-Packard (Purchase Discount and Marketing Agreement)	6/7/1999	MIC0000792- MIC0000818
Micron	Hewlett-Packard (Memo of Understanding)	6/20/2001 4/7/2000	MIC0002041- MIC0002049 MIC0000195- MIC0000201
Micron	Hewlett-Packard (Product Purchase Agreement)	2001 2002	MU00046257- MU00046307 MU00046632- MU00046684 MU00503317- MU00503371
Micron	Hewlett-Packard (Memo of Understanding)	2/28/2001	MIC0001847- MIC0001852

Manufacturer	Customer	Date	Bates Number
Micron	IBM (Long Term Agreement)	1/19/1999	MIC0000819-MIC0000822
Micron	IBM (Goods Agreement)	12/1/2001	MIC0000202-MIC0000220
Micron	IBM (Replenishing Statement)	2/26/2002	MIC0001734-MIC0001742
Micron	IBM (Long Term Agreement)	1/1/1999	MU00220881-MU00220882
Micron	IBM Singapore (Participation Agreement0	2/28/2001	MIC0001758-MIC0001763
Micron	InFocus	5/2002	MU00637984-MU00637988
Micron	Intel (Supply Agreement)	10/19/1998 5/1/2001 Amendment & Multiparty Agreement	MU00520645-MU00520660 MU00628567-MU00628950 MU00279901-MU00279903
Micron	Irish Express Cargo	4/1/1999	MU00490266-MU00490830
Micron	Kingpak	8/27/1999	MU00333645-MU00333655
Micron	Kingpak (Sales & Purchase Agreement)	8/27/1999 7/1/2002 amendment	MIC0001273-MIC0001289 MIC0001245-MIC0001272
Micron	Kingpak	8/27/1999	MU00333645-MU00333655
Micron	Kingston	3/31/2000	MIC0001744-MIC0001751
Micron	Kodak (OEM Agreement, Equipment)	4/28/2000	MU00241425-MU00241466
Micron	LA Services (Service and Inventory Storage Agreement)	7/1/1998 3/14/2000	MU00279696-MU00279704 MU00279763-MU00279777 MU00279825-MU00279826
Micron	Lexmark (packaging and handling guide)	5/19/1997	MIC0000823-MIC0000829
Micron	Lexmark (Non-binding letter of agreement_	1/19/2001	MIC0001804-MIC001807
Micron	Lexmark (Long Term Supply Agreement)		MIC0000830-MIC0000886